



# 2009 High Performance Computing Modernization Program Users Group Conference

US DoD S&T Priorities  
17 June 2009

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# The Next Phases of Development

## --Thoughts from the Secretary of Defense--



*"I believe the Department should seek increasing competition, use of prototypes, and ensure technology maturity so that our programs are ready for the next phases of development..."*

**Secretary Gates before the SASC,  
January 27, 2009**

***The strategy (National Defense Strategy) strives for balance in three areas: between trying to prevail in current conflicts and preparing for other contingencies, between institutionalizing capabilities such as counterinsurgency and foreign military assistance and maintaining the United States' existing conventional and strategic technological edge against other military forces, and between retaining those cultural traits that have made the U.S. armed forces successful and shedding those that hamper their ability to do what needs to be done.***

***Foreign Affairs Magazine Jan / Feb 2009***

**DDR&E VISION: To develop technology to defeat any adversary on any battlefield**

***Any Battlefield includes  
physical, cyber, space,  
undersea, etc***

***Any adversary includes both State & non-State actors***





# Forces of Change...



**NEW TECHNOLOGY NEEDED**  
*What does this mean for the Department...?*

# Our New World . .



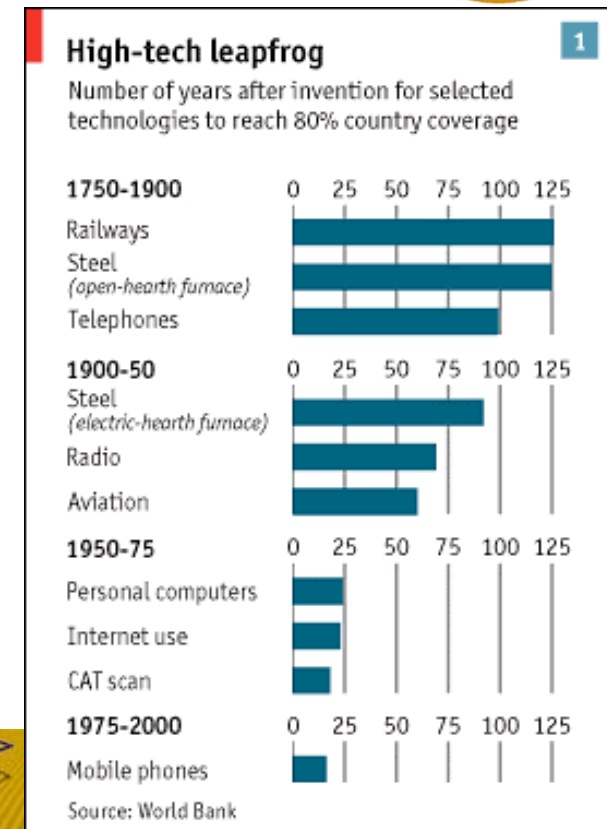
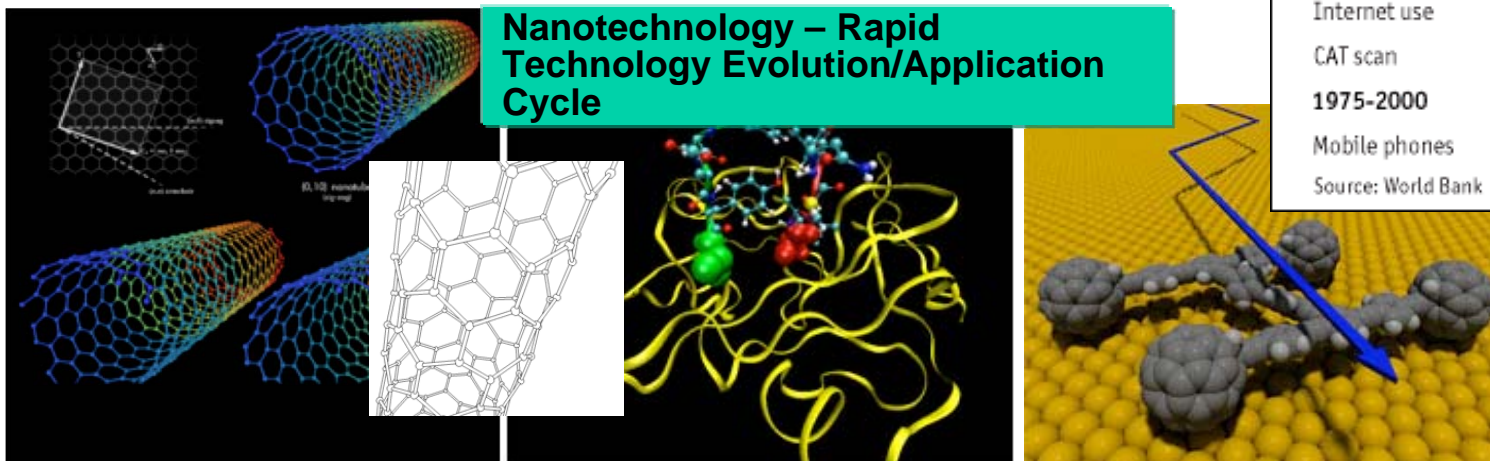
**When the rate of change outside your organization exceeds that within your organization, the end is near. - Jack Welch, former CEO, General Electric**



# Pace of Technology Continues to Increase



- Time between modeling of semiconducting properties of germanium in 1931 and first commercial product (*transistor radio*) was 23 years
- Carbon nanotube
  - Discovered by Japan (1991)
  - Researchers recognized carbon nanotubes were excellent sources of field-emitted electrons (1995)
  - “Jumbotron lamp” - nanotube-based light source available as commercial product (2000)

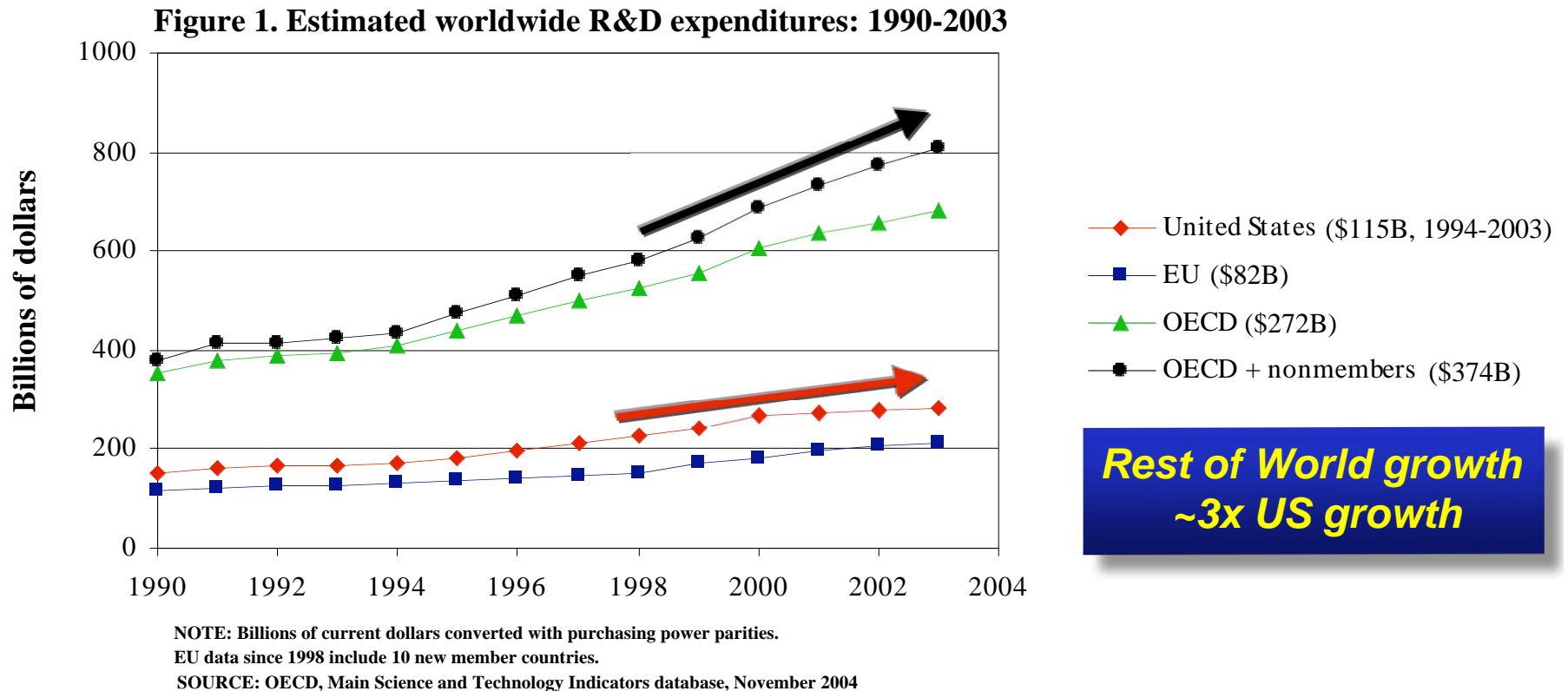


Source: The Economist, Feb. 9, 2008

# International R&D Trends



R&D expenditures are increasing robustly around the world, driven by both governments and industry.



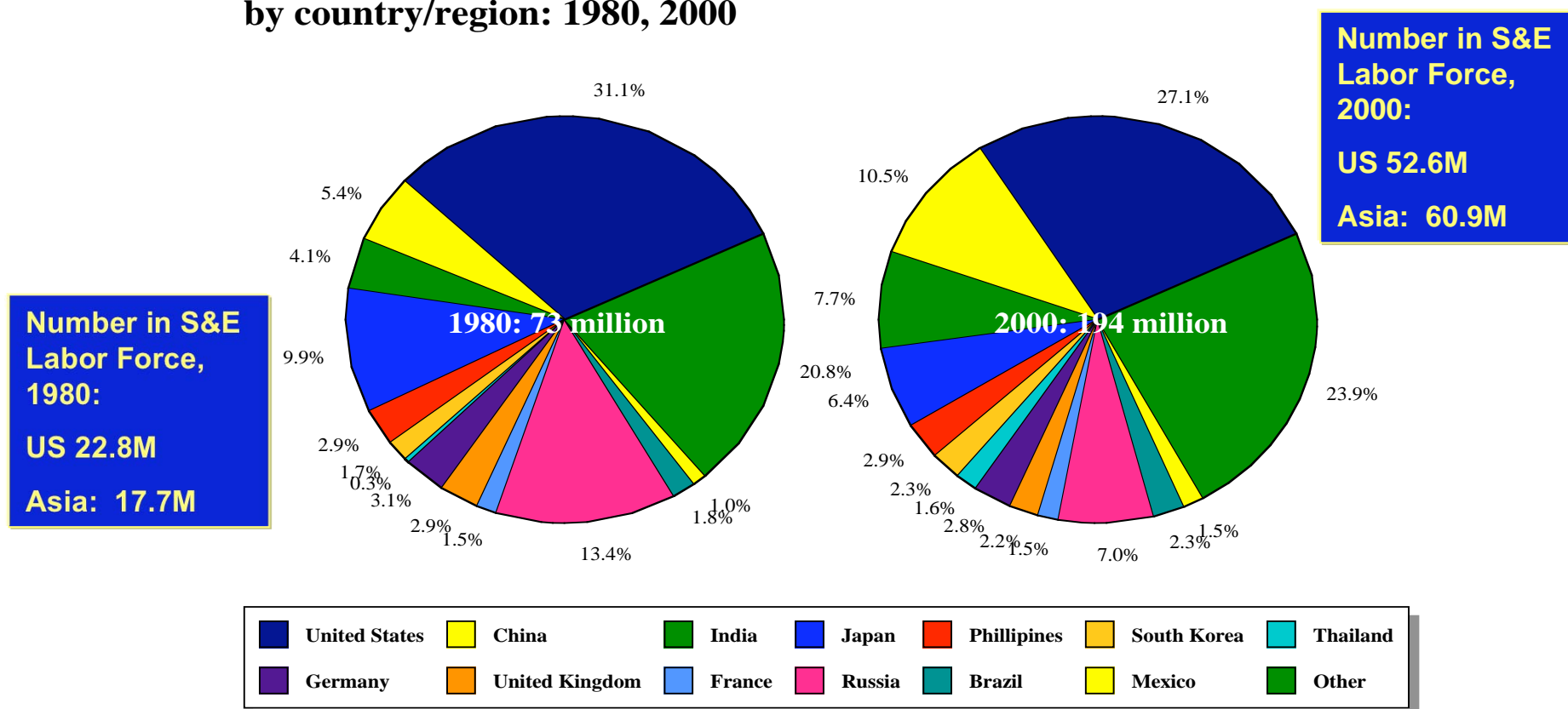




# Growth of Educated Asian Population

International S&E labor force data can only be approximated.

Figure 20. Population 15 years and older with tertiary education, by country/region: 1980, 2000



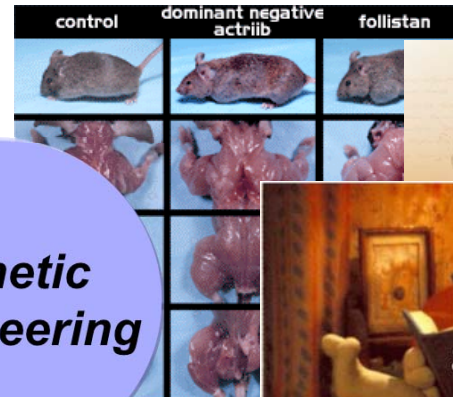
SOURCE: Adapted from R.J. Barrow and J. Lee, Center for International Development: International Data on Educational Attainment, 2000

# “Disruptive” Commercial Technologies



- Fundamentally can have global impact & change the balance and approach to force expression
- Drives and fuels the need for & new innovative concepts
- Includes how new capabilities are built on emerging technology
- Appearing increasingly from the global commercial marketplace

**Genetic Engineering**



**Future Processors**

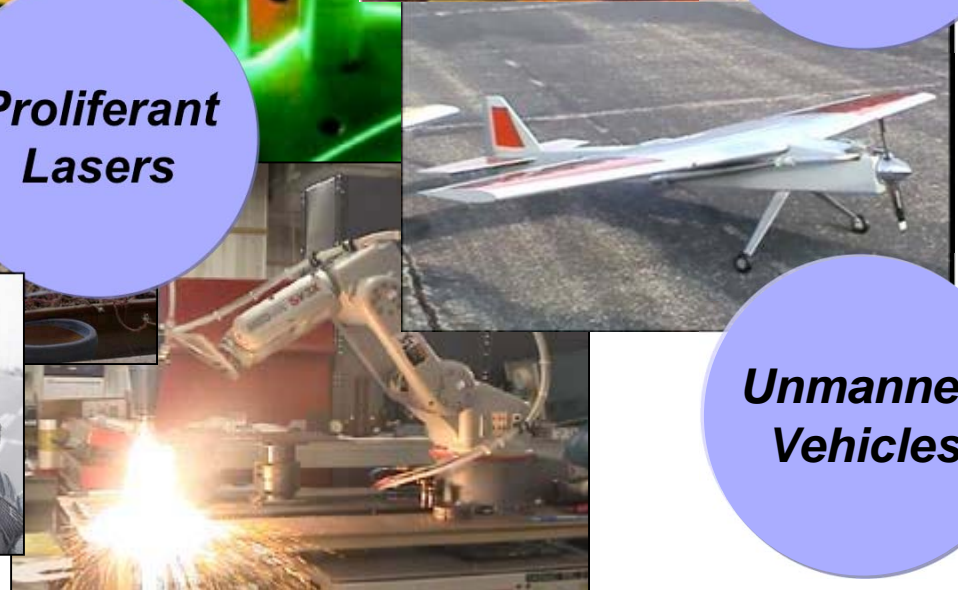


**Proliferant Lasers**

**Wireless Devices**



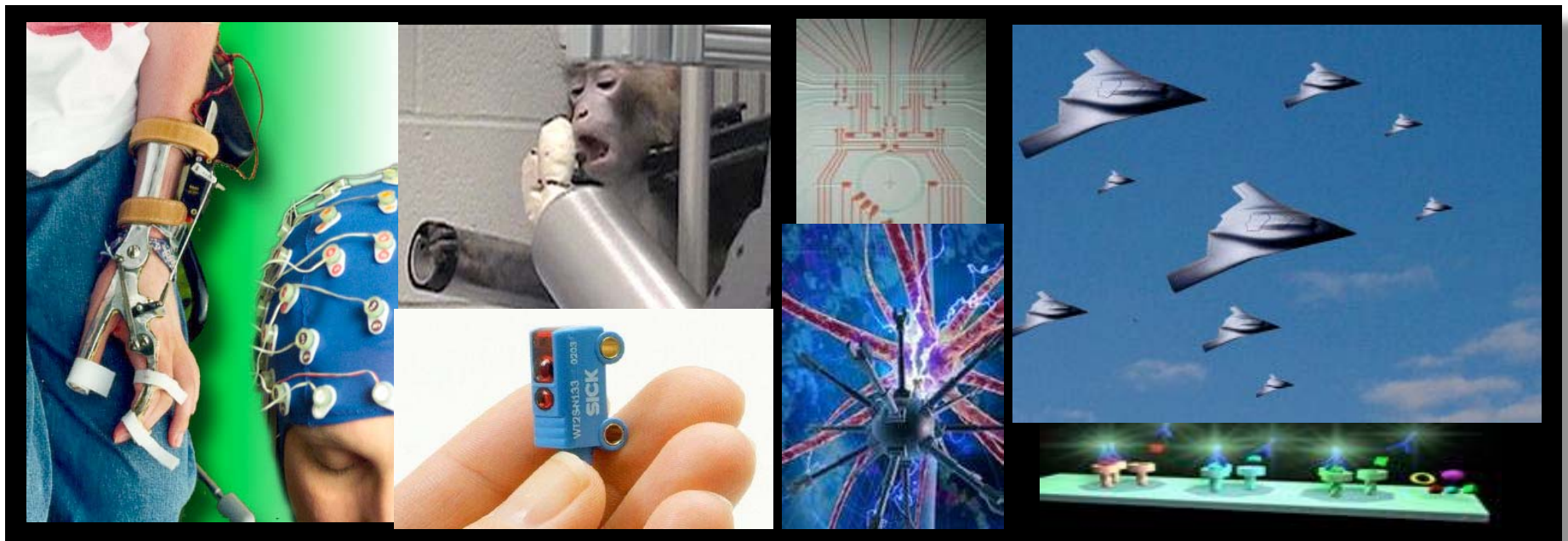
**Unmanned Vehicles**



# Implications



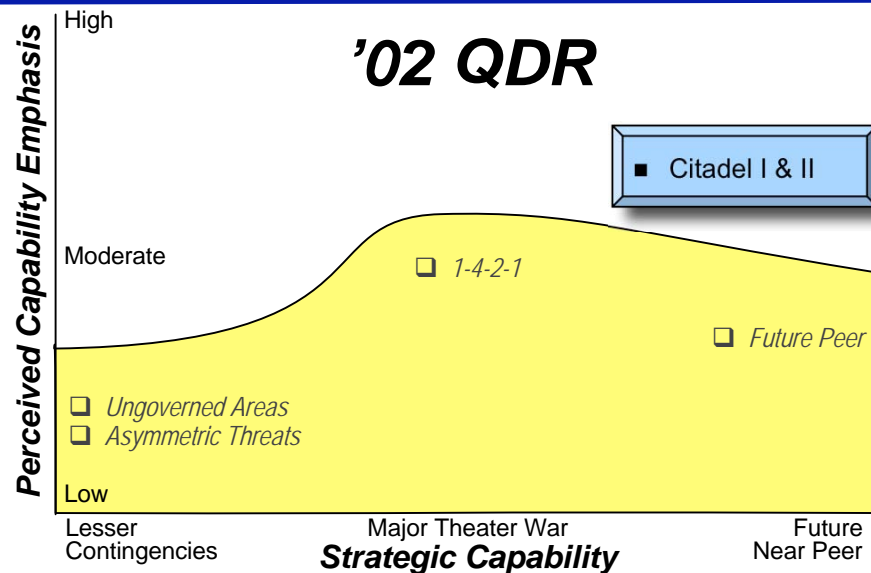
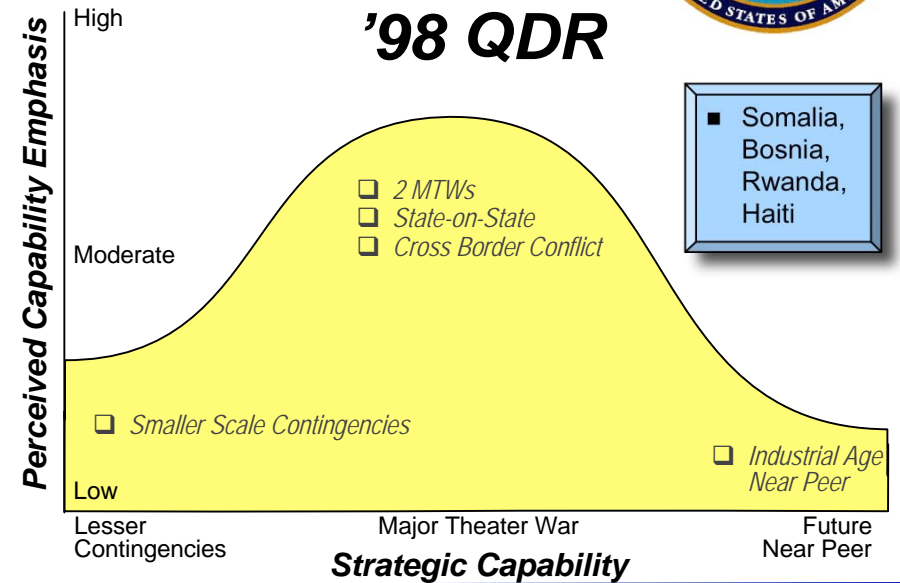
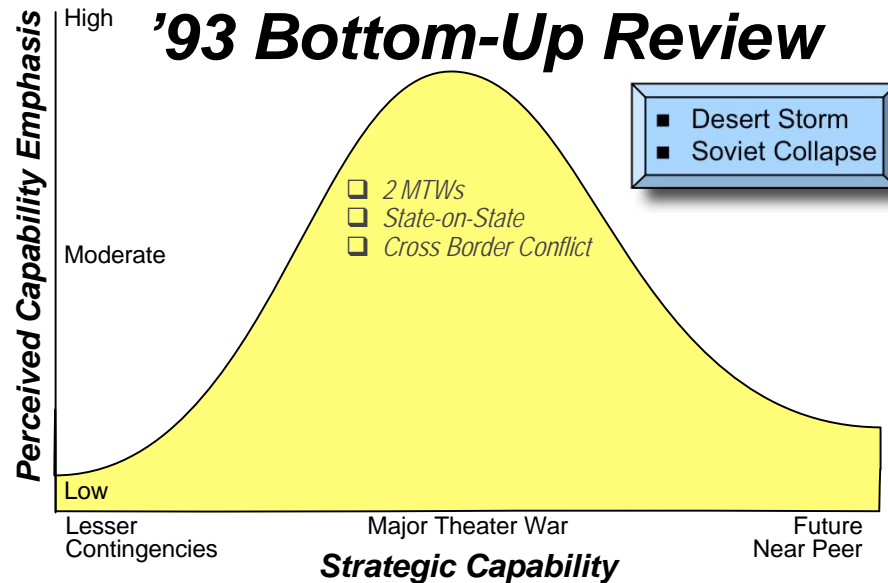
- Greater base of technology development, more agility than previous
- Probability of technology surprise – rapidly increasing
- Technology increasingly hybrid, commercial/military



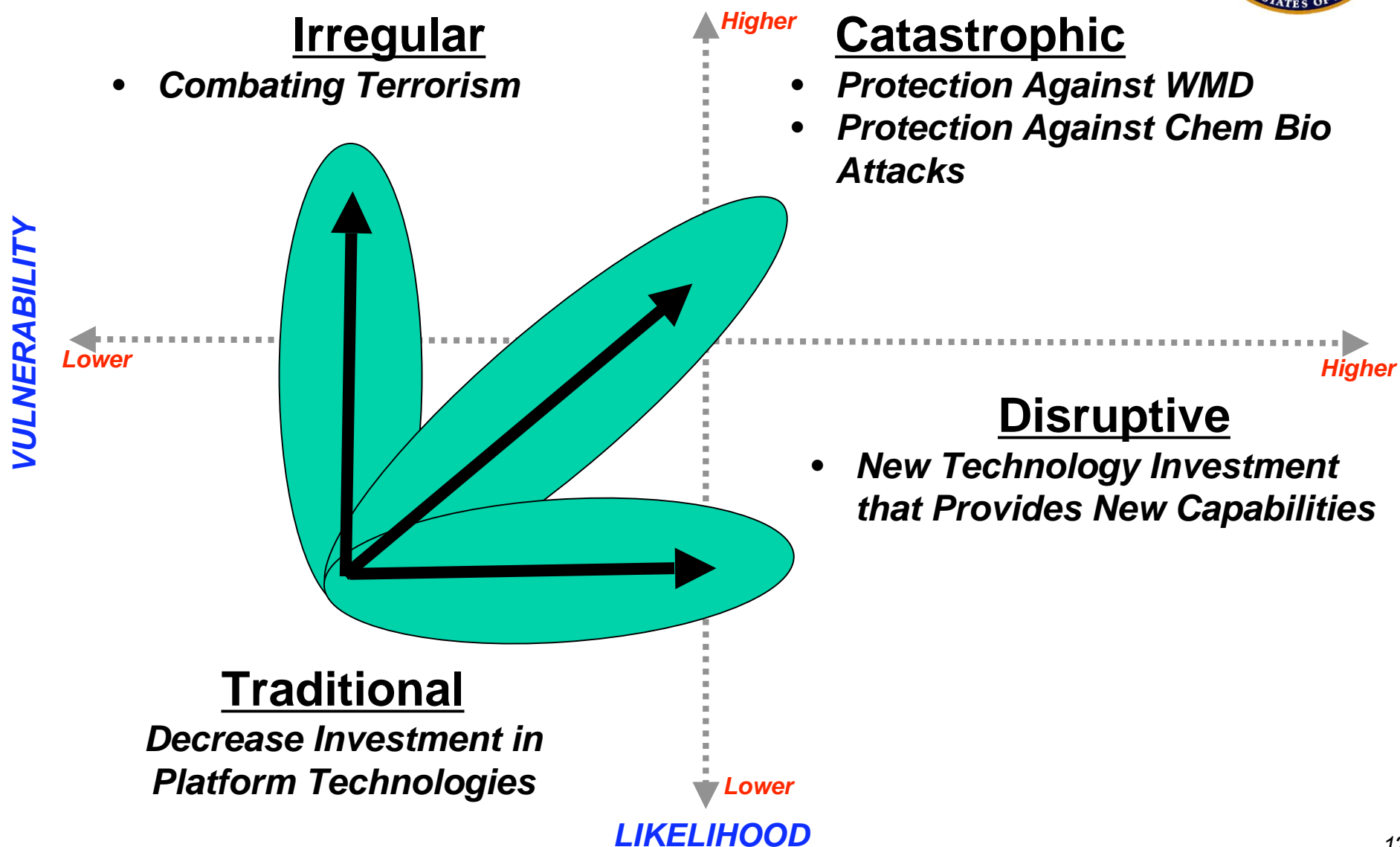
***Need Enhanced Technology Scouting and Investment***



# Decade of Strategic Evolution



# National Defense Strategy Drives Investment Strategy



# Science and Technology Enabling Technology Priorities

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Technology focus areas:

- Biometrics and Biological exploitation
- Information technology and applications
- Persistent Surveillance Technology
- Networks and Communication
- Human, Social, Cultural, and Behavioral Modeling
- Language
- Cognitive Enhancement
- Directed Energy
- Autonomous systems
- Hyperspectral sensors
- Nanotechnology
- Advanced Materials
- Energy and Power
- Affordability
- Combating Weapons of Mass Destruction Technologies
- Energetic Materials

*In Blue -- Areas with  
Substantial  
High-Performance  
Computer Needs*



# Big Moves Last Three Budgets



## *FY2008 (~\$1.5B across the FYDP)*

Biometrics Research (~\$70M)  
 Human Cultural Social  
     Behavioral Modeling (~\$210M)  
 Networked Communications (~\$190M)  
 Persistent Surveillance (~\$100M)  
 Energy Research (~\$150M)  
 Clandestine TT&L (~\$300M)  
 Armor Technology (~\$200M)  
 Manufacturing S&T (~\$100M)

## *FY2009 (~\$2B across the FYDP)*

Basic Research (~\$1.5B)  
 Increased Protection Demonstrations  
     for Dismounted Troops (~\$200M)  
 Novel LO/CLO Technologies (~\$150M)  
 Cyber Protection (~\$100M)  
 Anti-tamper Technology  
     (~\$10M – to be completed in FY10)

## *FY2010 (~\$2.2B across the FYDP)*

Medical S&T (Wounded Warrior) (~\$2.5B total; about \$1B in S&T, the rest in  
 Defense Health Protection)  
 Large Data Handling (ISR Capability) (~\$100M)  
 Expanded Cyber Protection and Anti-Tamper (~\$450M)  
 High Temperature Materials (~\$70M)  
 Stand-off Detection of Fissile Materials (~\$300)  
 High Performance Computing (~\$100M)  
 Minerva (Sociology Research) (~\$100M)

### Key

Joint Programs  
 Multiple  
 Executors  
 Army  
 Navy  
 Air Force

# DoD HPC Modernization Program



## DoD Supercomputing Resource Centers



## Program Motivation

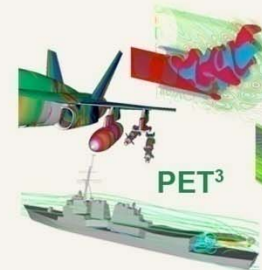
Provide the DoD research, development and test and evaluation (RDT&E) community the world-class commercial, high-end, high-performance computational capability they need to rapidly apply advanced technology to develop superior Warfighting capabilities.

## Software Applications Support

Institutes/Portfolios



Education & Outreach



PET<sup>3</sup>



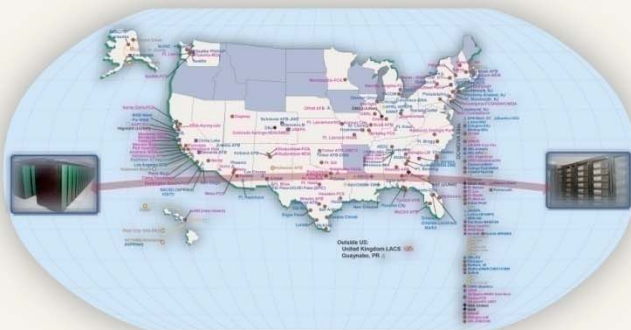
CREATE

SPI



## Networking

Defense Research & Engineering Network



## Approach

Develop and subsequently sustain complete and balanced HPC environments based on user requirements to solve the most demanding problems.

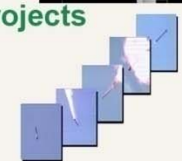
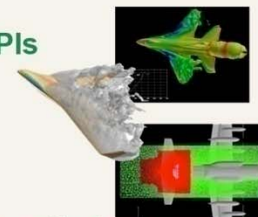
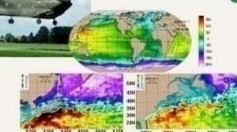
## Resource Management Requirements & Allocations



DHPIs



Challenge Projects



# DoD HPCMP Activities



- Since 2006, the DoD HPCMP has completed three Return on Investment (ROI) Studies
  - Armor, Anti-Armor Portfolio
    - Climate/Weather/Ocean (CWO)
    - Air Vehicles
- Develop and implement validated and repeatable processes
- When appropriate, involved the Operational Warfighter

**Directly shaped success of Secretary Gates' #1 Acquisition Program: Mine Resistant Ambush Protected (MRAP) Vehicles**





# Interim Frag Kit 6 (IFK6) for UAH: From HPC to Iraq in < 4 Months



- HPC assets provided complete conceptualization of candidate designs
- HPC used to examine mechanisms, screen design options, and down select final armor configuration.
- Verification testing proved HPC design methodology and validated accelerated fielding by reliance on a closely coupled HPC/experimental approach.
- IFK-6 based designs developed for many other platforms including RCVs & MRAPs



# Significant Quantities of MRAPs Fielded in < 2 years



- IFK6 supported MRAP research
- Multiple alternative technologies examined through coupled HPC & Experimentation
- HPC used to examine technologies and system designs to optimize solutions.
- Verification testing proved HPC design methodology and validated accelerated fielding by reliance on a closely coupled HPC/experimental approach.



# Three Principal Objectives

## -DoD Strategic Imperatives-

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### *Secretary of Defense Posture Statement on the FY2009 Budget, February 2008*

“As changes in this century’s threat environment create strategic challenges – irregular warfare, weapons of mass destruction, disruptive technologies – this request places greater emphasis on **basic research**, which in recent years has not kept pace with other parts of the budget.”



### *Secretary of Defense, Budget Recommendation Statement, Arlington, VA, April 6, 2009*

1. Take care of our people
2. Develop the right capabilities for today and tomorrow
  - Persistent surveillance
  - Cyberspace operations/protection
  - Combating weapons of mass destruction
  - Irregular warfare
3. Reform the Procurement, Acquisition, and Contracting processes



# SecDef Strategic Imperative

- Objective 1: Take care of our people -

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- Personnel & Platform Protection
- Advanced Medical Research
- Education



# SecDef Strategic Imperative

## Objective 2: Develop the right capabilities for today & tomorrow -



- **Combating Weapons of Mass Destruction**
- **Advanced Tagging, Tracking, & Locating**
- **Cyberspace Operation/Protection Technologies**
- **Battlespace Awareness**
- **Energy & Power**
- **Unmanned Vehicles**
- **Advanced Electronics**
- **Advanced Materials**
- **Processing Large Data Sets**
- **Intelligence, Surveillance & Reconnaissance**
- **Human, Social, Cultural, Behavior Modeling**
- **Software Development**



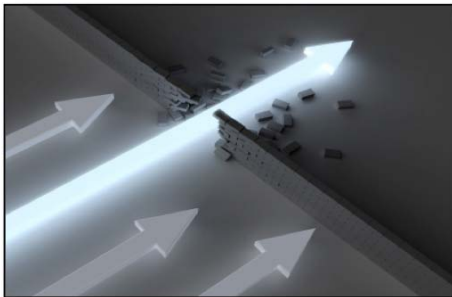
# SecDef Strategic Imperative

- Objective 3: Reform the Procurement, Acquisition & Contracting processes -



## Four new “organizations”:

- Director of Cost Assessment and Program Evaluation (CAPE)
  - Formerly PA&E (Program Assessment and Evaluation)
- Director of Systems Engineering
  - Formerly SSE
  - Consolidate all pre-MS B efforts within DDRE
- Director of Developmental Test
  - Independent entity
- “Senior official” for Performance Assessment and Root Cause Analysis
  - Consolidate efforts with Program Systems Review (PSR)



# Acquisition Reform Act - 2009

## Responsibilities

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- Technology Maturity Assessments (TMA's)
  - Periodic reviews of all MDAP's
  - Annual congressional report
  - Assess technology maturity and *integration risk (new)*
- Systems Engineering
  - Assess SEP's and development planning for all MDAPs
  - Oversee SE workforce and certification process
  - Review Service SE organizations
- Developmental Test and Evaluation
  - Assess DT&E plans for all MDAPs
  - Review Service DT&E organizations



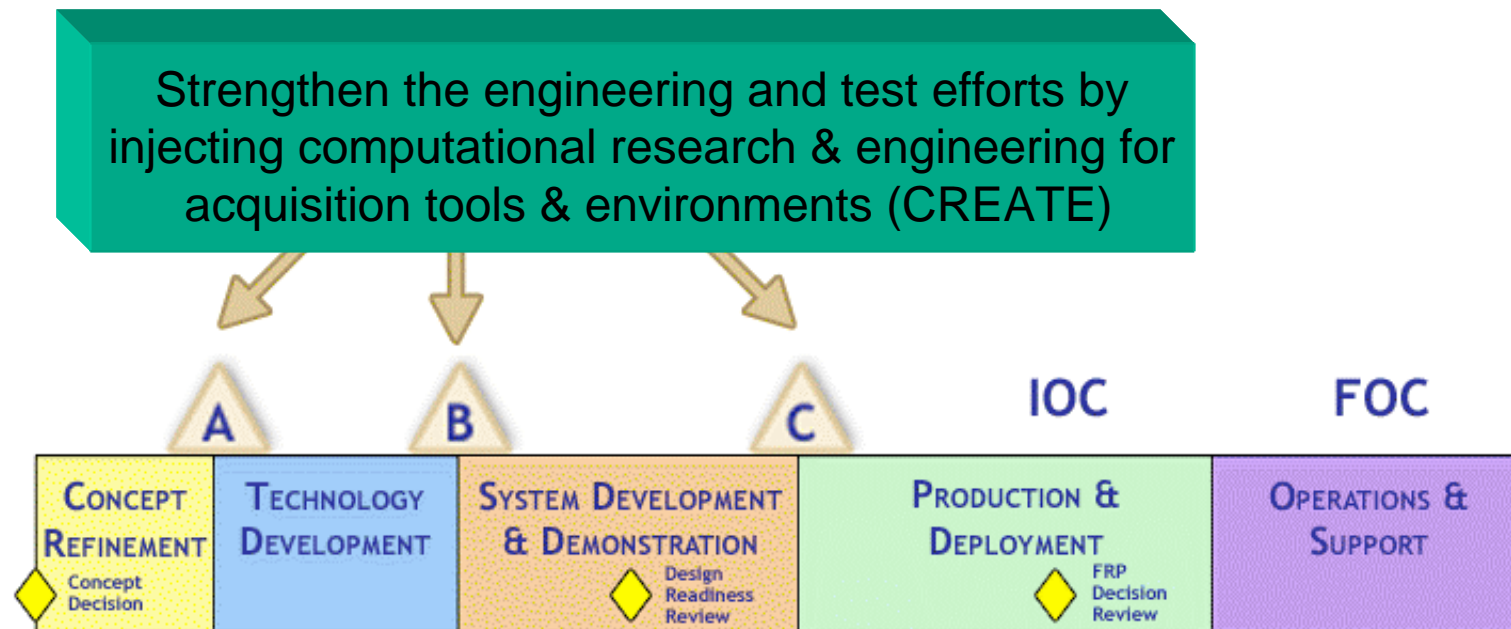
# The Challenge & Opportunity



## The Challenge:

“Unfortunately, our assessments do not show appreciable improvement in the acquisition of major weapon systems. Rather, programs are experiencing recurring problems with cost overruns, missed deadlines, and performance shortfalls.” page 1, GAO-06-391, similar concern page 70 QDR

## The Opportunity:

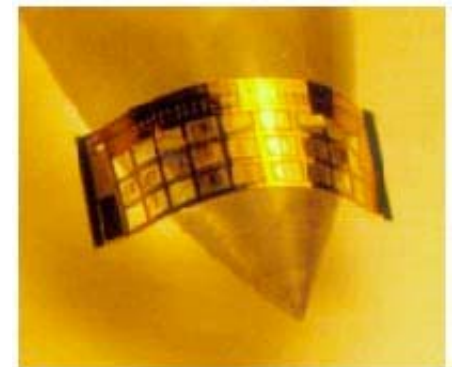
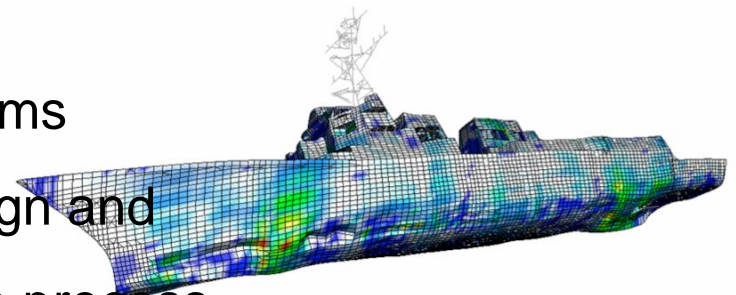
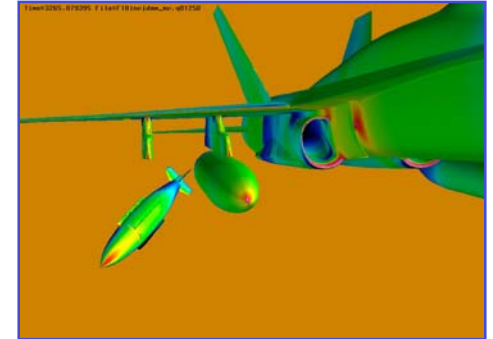


# Computational Research and Engineering Acquisition Tools and Environments (CREATE)

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- CREATE will insert modern engineering practices and advanced technology into the early phases of the acquisition process to make it more effective.
- CREATE will strengthen the weapon systems technology development, engineering design and test & evaluation portions of the acquisition process yielding more highly optimized designs faster, allowing better and faster tests resulting in more capable weapon systems that cost less.



# Why does the DoD need CREATE?



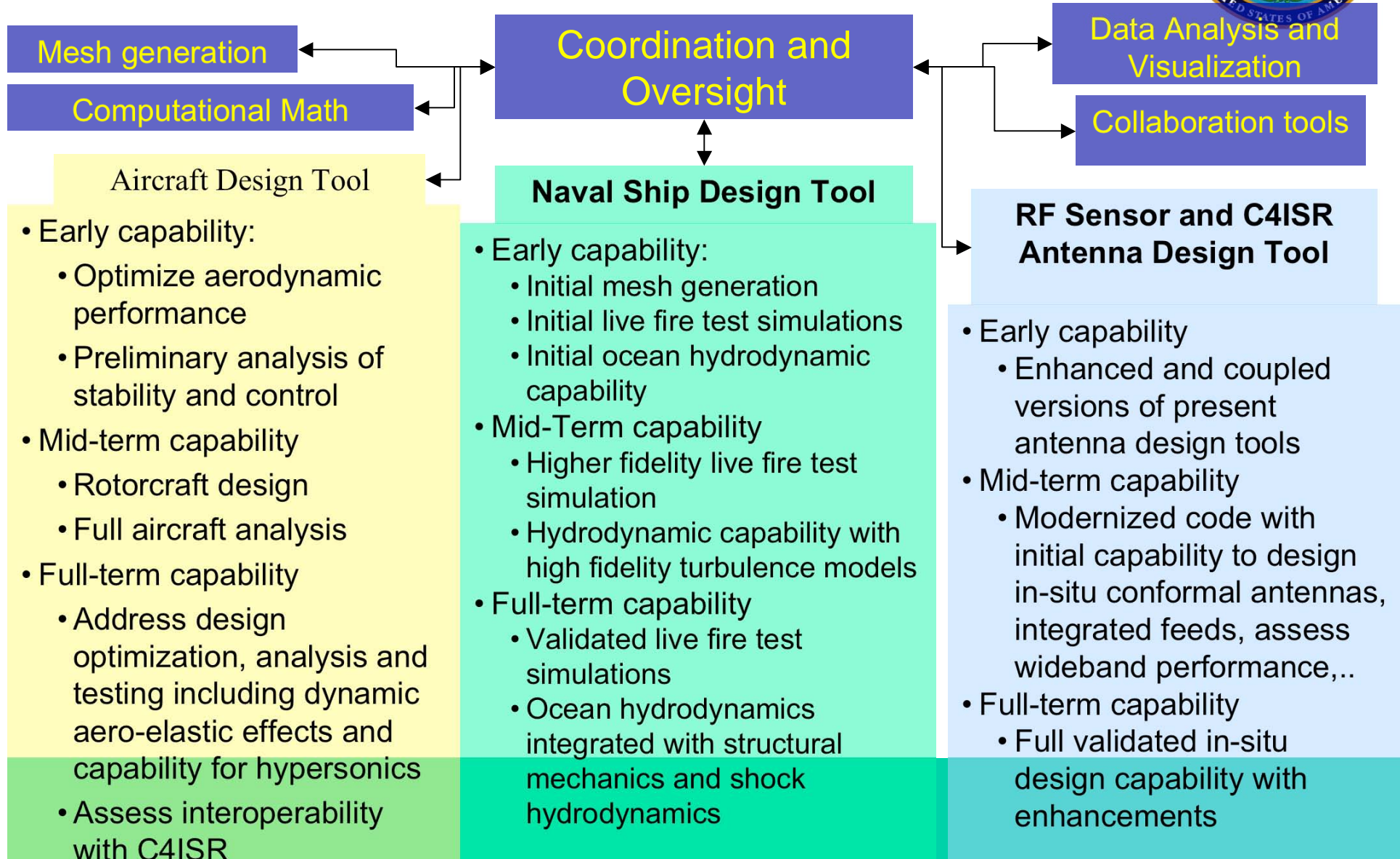
- Top-down direction: The QDR states (pp. 16, 67-71, A-6) that a more effective, and agile and flexible acquisition process is a high priority.
  - Many weapons systems are over-budget, late, and don't meet performance goals (e.g. GAO-06-391 (March 2006)).
  - Lengthy and rigid acquisition process degrades ability to address rapidly changing irregular, catastrophic and disruptive threats.
- Many of these problems can be traced to an ineffective design process.
- Our present design tools are inadequate to produce an integrated design with few flaws.





# CREATE Tools

## Delivered Incrementally (over 10 years) in a resource-sharing environment



**VISION: To develop  
technology to defeat any  
adversary on any battlefield**

*Any Battlefield includes  
physical, cyber, space,  
undersea, etc*

**QUESTIONS?**

